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⑫ **EUROPEAN PATENT APPLICATION**

⑪ Applicant: **Aeronautical & General Instruments Limited,**
40 Purley Way, Croydon, CR9 3BH (GB)

㉒ Inventor: **Daw, Ronald Edgar, 2 Lone Pine Way Ferdown,**
Wimborne Dorset (GB)

㉔ Representative: **Rackham, Stephen Neil et al, GILL**
JENNINGS & EVERY 53/64 Chancery Lane, London
WC2A 1HN (GB)

㉔ **A method and apparatus for calibrating a coin validation apparatus.**

㉗ A method of calibrating a coin validation apparatus including a coin testing section (1) and a programmable memory (3) comprises subjecting two tokens successively to a coin test using the coin testing section (1) to determine the values of two parameter signals for each token which are characteristic of the effect of each token on the coin testing section (1). These determined parameter values for the two tokens are then compared with standard values of the parameter signals for the two tokens, and from the determined parameter values and the standard values, calibration factors relevant to that particular coin testing section (1) are computed. Standard values of the parameter signals for a set of coins to be used with the coin validation apparatus are then operated on using the computed calibration factors to compute individual reference values of the parameter signals for each coin in the set appropriate for that particular coin testing section (1). Finally, the programmable memory (3) is programmed with these computed individual reference values. An apparatus for performing this method includes two tokens, a programmed memory (5) containing standard values of the parameter signals for the said two tokens and standard values for coins acceptable to the validation apparatus, and a programmed computer (4).

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A METHOD AND APPARATUS FOR CALIBRATING A COIN VALIDATION
APPARATUS

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Coin validation apparatus may be associated with a coin freed mechanism on a variety of coin receiving machines such as coin box telephones or vending machines or may form part of a coin sorting apparatus to check that coins are valid coins and not counterfeit. There are many different types of coin validation apparatus in use, but recently, with the introduction of modern electronic devices to control the operation of the coin receiving machines and sorting apparatus, it has become particularly convenient to use the interaction between a coin and an alternating magnetic field to gauge various parameters of the coin thereby to determine if the coin is valid.

Our co-pending European Patent Application No 82301161.4 describes a particularly convenient form of coin validation apparatus comprising a coin testing section, a microprocessor which controls the operation of the apparatus and analyses the output of the coin testing section, and a programmable memory containing the individual reference values for valid coins. The coin testing section includes an electrical coil through which, in use, an alternating current is fed to produce an alternating magnetic field and a coin to be tested is placed adjacent the coil in the alternating magnetic field. The coin testing section produces two parameter signals which are characteristic of the effect of the coin on both the inductance and the loss factor of the coil. With such an apparatus, these two parameter signals are then compared with reference values from the programmable memory by the microprocessor to determine if the coin is valid. However, the particular parameter signals that are generated by the coin testing section also depend to

some extent, upon the particular component values,
tolerances, physical sizes, and location of the elements
making up the coin testing section and thus, the exact
value of the signal that indicates a valid coin in one
5   coin testing section is likely to be different from
the exact value of the signal in a different but similar
piece of apparatus. The present invention is concerned
with a method and an apparatus for calibrating the
coin testing sections of such electronic coin validation
10   apparatus to determine the appropriate reference values
for the parameter signals that are characteristic of the
effect of the coin on the coin testing section.

At present such calibration is performed by
inserting a typical coin of the appropriate denomination
15   into the coin test section and then subjecting it to a
test. The values of the particular parameters that are
obtained as a result of this test are then programmed
into the memory and subsequently this stored value is
used as the reference value of that parameter for coins
20   of that denomination.

Naturally there is some spread in the parameters
of valid coins. This spread results from tolerances in
their manufacture and also from differences caused by
wear in use. When a coin validator is calibrated using
25   a typical coin a large number of valid coins of a par-
ticular denomination have to be sampled and then a coin
is chosen as having representative parameters when its
parameters are in the middle of the sample parameter
distribution. It is then this representative coin that
30   is used as the standard with which the apparatus is
calibrated. Thus, supposing the apparatus is intended
to accept 5p, 10p, and 50p coins, a representative coin
of each denomination has to be found and then these
coins are fed into the apparatus and the particular parameter
35   signals produced by them used to program the memory and

hence calibrate the apparatus. Thus, in future, the
apparatus compares every coin inserted into it with
these particular parameters and if the coin has the same
parameters or is very close to these parameters, the
apparatus recognises it as a valid coin of a particular
denomination.

     There are many disadvantages with this system of
calibration. It is difficult and time consuming to find
representative coins having typical parameter values
falling in the middle of a sample distribution of
parameter values for valid coins of a particular denom-
ination. Then, having located such a representative
coin it is impossible to identify or label it without
changing its parameters. Thus, once a representative
coin has been found it is undistinguishable from any
other coin by simple visual observation and consequently
it is very easy for that representative coin to be
mislaid or exchanged for a non-representative coin
without anyone being aware of that fact. If this occurs
then this naturally leads to errors in subsequent cali-
brations. Further, a separate calibration has been
performed with a standard coin of each denomination with
which the apparatus is to be used. This increases the
difficulty in finding and then keeping distinct, appro-
priate representative coins. Naturally, after any
replacement or repair to the coin testing section of the
apparatus it has to be recalibrated and consequently
it is desirable to be able to calibrate the apparatus on
site with some easily portable reference or references.
If this is to be done with representative coins firstly
a large number of such coins have to be found and then
strict control has to be exercised over all of them to
ensure that they are not exchanged for other visually
similar but not representative coins. In practice this
has been found to create great difficulties.

It has also been proposed to use tokens, with the
same parameters as representative coins, as the references
with which the apparatus is calibrated. This has the
advantage that the tokens would be identifiable but

5   it is extremely difficult to manufacture such tokens to
ensure that they have the same characteristics as valid
representative coins. Such tokens also have to be pre-
pared for all denominations of coins in the coin set to
be used with the apparatus and for all of the coins in

10   the various different currencies with which the apparatus
may be used.

The particular values of the two parameters charac-
teristic of the valid coin of each particular denomination
can be thought of as points, on a two dimensional graph

15   with the two parameters forming the axes of the graph.
In the example referred to above the axes would be
the inductance and loss factor of the coil and thus, for
each denomination of coin there would be a particular
point on this graph having particular co-ordinates for

20   both inductance and loss factor. It is the co-ordinates
of this particular point which form the reference values
for a particular denomination of coin. In practice,
because of the spread in the characteristics of valid
coins caused by such things as wear what needs to be

25   determined are the co-ordinates of a small area on the
graph representing the acceptable range in parameter
values for acceptable coins. Naturally, the particular
location of the points or small areas on such a graph
which represent the reference values vary from one coin

30   testing section to another depending upon the idiosync-
racies of the individual elements in the coin testing
section. However, we have discovered that the differences
between the locations of such reference points in
different pieces of apparatus can be represented and

35   taken account of by moving the origin of the axes and

by applying a scaling factor to each of the axes on such a graph and the present invention makes use of this discovery.

According to a first aspect of this invention a method of calibrating a coin validation apparatus including a coin testing section and a programmable memory comprises subjecting two tokens successively to a coin test using the coin testing section to determine the values of two parameter signals for each token which are characteristic of the effect of each token on the coin testing section, comparing these determined parameter values for the two tokens with standard values of the parameter signals for the two tokens and computing from the determined parameter values and the standard values calibration factors relevant to that particular coin testing section, then operating on standard values of the parameter signals for a set of coins to be used with the coin validation apparatus using the computed calibration factors to compute individual reference values of the parameter signals for each coin in the set appropriate for that particular coin testing section, and programming the programmable memory with these computed individual reference values.

Once the calibration factors for any particular coin testing section have been derived, the calibration factors that are obtained are appropriate irrespective of the nature or currency of the coins with which the apparatus is to be used. Consequently, the memory of the coin validation apparatus can be programmed for coins of any number of denominations and coins of any currency by simply determining the appropriate calibration factors from the two tokens and then operating on standard values for any particular coins of any particular currency using these calibration

factors. No matter how many coins are present in the
set of coins of any particular currency, all that is
required to determine the calibration factors and
calibrate the apparatus are the tests on two simple
5   tokens. The tokens are produced specifically as cali-
bration tokens and thus do not look like coins and
so are not likely to be mistaken or exchanged with
coins without this being immediately apparent. The
tokens are not accepted by the validation apparatus as
10   valid coins and the tokens have no intrinsic value
other than that of being calibration tokens. Conse-
quently they are not likely to get lost or exchanged
for coins. The calibration tokens do not have to
mirror any particular coin in their magnetic and elec-
15   trical parameters although naturally they must have
broadly similar parameters and so be formed of metal
discs.

        According to a second aspect of this invention an
apparatus for calibrating a coin validation apparatus
20   including a coin testing section and a programmable
memory comprises two tokens, a programmed memory
containing standard values of the parameter signals for
the said two tokens and standard values for coins
acceptable to the validation apparatus, and computer
25   means programmed to accept from the coin testing section
determined values of two parameter signals for each
token which are characteristic of the effect of each
token on the coin testing section, to compare these
determined parameter values for the said two tokens with
30   the standard values of the parameter signals for the two
tokens stored in the programmed memory, to compute from
the determined parameter values and from the standard
values of the parameter signals for the two tokens,
calibration factors relevant to the coin testing section
35   of that particular coin validation apparatus, to operate on

the standard values of the parameter signals for the
coins acceptable to the coin validation apparatus stored
in the programmed memory using the computed calibration
factors to compute individual reference values of the
parameter signals for each coin acceptable to the coin
validation apparatus appropriate for that particular coin
testing section, and to program the programmable memory
of the coin validation apparatus with these computed
individual reference values of the parameter signals.

The apparatus in accordance with the second aspect
of this invention is usually referred to as a calibration
unit and preferably comprises a microprocessor forming the
computer means coupled to the programmed memory. This
microprocessor is preferably of the same type as that
used in the coin validation apparatus and, during cali-
bration of the apparatus it replaces that normally used
in the coin validation apparatus. Of course, the
microprocessor in the calibration unit is programmed
differently from that normally used in the apparatus.
The tokens, the programmed microprocessor and the
programmed memory form a readily portable assembly which
can be transported to any site at which the coin valid-
ation apparatus is situated to enable the coin validation
apparatus to be programmed on site.

According to a third aspect of this invention a
coin validation apparatus includes a coin testing section
for testing a coin and determining the values of two
parameter signals which are characteristic of the effect
of the coin on the coin testing section, a programmable
memory for storing individual reference values of the
parameter signals corresponding to valid coins acceptable
to the coin validation apparatus, two tokens, a programmed
memory containing standard values of the parameter signals
for the said two tokens and standard values of the
parameter signals for coins acceptable to the coin valid-

ation apparatus, and computer means programmed to accept
from the coin testing section determined values of the
two parameter signals for each token which are charac-
teristic of the effect of each token on the coin testing

5   section, to compare these determined parameter values
for the two tokens with the standard values of the
parameter signals for the two tokens stored in the pro-
grammed memory, to compute from the determined parameter
values and from the standard values of the parameter

10   signals for the two tokens calibration factors relevant
to the coin testing section of that particular coin
validation apparatus, to operate on the standard values
of the parameter signals for the coins acceptable
to the coin validation apparatus stored in the programmed

15   memory using the computed calibration factors to compute
individual reference values of the parameter signals for
each coin acceptable to the coin validation apparatus
appropriate for that particular coin testing section, and
to program the programmable memory of the coin validation

20   apparatus with these computed individual reference values
of the parameter signals.

Such a coin validation apparatus may be formed by a
coin validation apparatus including the calibration
apparatus or calibration unit in accordance with the second

25   aspect of this invention, or alternatively, the coin
validation apparatus may include the means to calibrate it
as a permanent part of the coin validation apparatus.
In this latter case, the computer means for calibrating
the apparatus is preferably the same microprocessor as is

30   used in the coin validation apparatus to control the
apparatus and to analyse the output of the coin test
section.   There is some additional means provided to
initiate the calibration sequence, for example in
response to the actuation of a switch or in response to the

35   first coin or token introduced when the programmable

memory is in its virgin state.

The standard values of the parameter signals for the tokens and for the coins acceptable to the coin validation apparatus contained in the programmed memory may

5   correspond to the exact values of the parameter signals emitted by a standard coin test section, but preferably they are presented in a modified form to facilitate the computation to be performed by the computer means.

Provided that the standard values of the parameter signals

10   for the said two tokens and the standard values for the coins acceptable to the coin validation apparatus are all modified in the same way, for example by all being divided by the same number, then when the calibration factors are computed during the calibration sequence this modification

15   of the standard values is taken account of in the calcu- lation of the calibration factors.

A particular example of a method and apparatus in accordance with this invention will now be described with reference to the accompanying drawings; in which:-

20   Figure 1 is a block diagram of a coin validation apparatus to be calibrated;

Figure 2 is a block diagram of the calibration system in operation;

Figure 3 is a further block diagram of the apparatus;

25   and,

Figure 4 is a flow chart of a computer program for use   in the calibration apparatus.

A typical coin validation apparatus is described in our earlier European Patent Application No 82301161.4

30   which was filed in the European Patent Office on 8th . March 1982.

This coin validation apparatus can be most simply thought of as comprising three . separate parts namely a coin test section 1, a microprocessor 2 which controls the

35   coin validation apparatus and performs an analysis on the

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output of the coin test section, and a programmable read
only memory PROM 3 which, once the coin validation apparatus
has been calibrated, contains reference values of coins
acceptable to the coin validation apparatus. The coin
5 test section 1 of the coin validation apparatus described
in our earlier Patent Application referred to above
comprises an electrical coil connected in a resonant
feedback circuit of an oscillator. The coin to be tested
is placed adjacent the coil and the presence of a coin
10 adjacent the coil influences the inductance and loss factor
of the coil and hence influences the oscillation frequency
and amplitude of the resonant feedback circuit of the
oscillator. The coin test section 1 emits two parameter
signals for each coin and these two parameter signals are
15 characteristic of the effect of the coin on the inductance
and loss factor of the coil.

These parameter signals are compared with reference
signals located in the PROM 3 by the microprocessor 2
and then the microprocessor 2 emits a valid or reject
20 coin signal depending upon whether the values of the
parameter signals obtained from the coin test section 1
correspond to those in the PROM 3 or not. The micro-
processor preferred for this function is type RCA 1802
manufactured by Radio Corporation of America.

25 Values of components, their electrical tolerances
and the exact size and location of the elements forming
the coin test section 1 of the apparatus cause the exact
value of the parameter signal output by the coin test section
1 to vary from one piece of apparatus to another, generally
30 similar, piece of apparatus. Thus it is necessary to program
the PROM 3 with individual reference values for the coins
that are to be acceptable to the coin validation apparatus
corresponding to the particular idiosyncracies of the coin
test section 1.

35 The preferred way of calibrating such a coin valid-

ation apparatus is to use a calibration unit consisting
of two reference tokens A and B (not shown), a programmed
microprocessor 4 which is again of RCA type 1802, and a
programmed read only memory PROM 5 containing standard

5   values of the parameter signals corresponding to cali-
bration tokens A and B and corresponding to each of the
coins with which the apparatus is to be used. For
example, a 50p coin, a 10p coin, a 5p coin and a 2p coin.
The parameter signals output from the coin test section 1

10   of the coin validation apparatus described in our earlier
patent specification has the form of variable frequency
signals. Table I shows the frequencies of typical output
signals from the coin test section 1 for the calibration
tokens A and B and the coins.

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<div align="center">T A B L E   I</div>

	Frequencies of typical parameter signals	
	Inductance Frequency (x)	Loss Factor Frequency (y)
Calibration Token A	$A_{(x)}$ 1479Hz	$A_{(y)}$ 993Hz
Calibration Token B	$B_{(x)}$ 4422Hz	$B_{(y)}$ 1999Hz
50p coin	$50_{(x)}$ 4319Hz	$50_{(y)}$ 2748Hz
10p coin	$10_{(x)}$ 3315Hz	$10_{(y)}$ 2433Hz
5p coin	$5_{(x)}$ 645Hz	$5_{(y)}$ 917Hz
2p coin	$2_{(x)}$ 2948Hz	$2_{(y)}$ 660Hz

The values of the calibration tokens A and B are
the most significant as they are used for calibration of
the apparatus and inspection of Table I shows that the

30   values of the parameter to signals of tokens A and B are
in an approximate 3:1 ratio. Using a microprocessor such

as the RCA type 1802 it is desirable to be able to
operate on information using only 8 bits of binary data
i.e. on numbers in a range from 0 to 255. Bearing this
in mind, suppose calibration token A is given values of 32
5　　and 32 and calibration token B values of 96 and 96 then
both the sum and the difference of these values are
exact multiples of 2.　　Giving the tokens A and B these
values will greatly simplify the calculations to be
performed by the microprocessor 4 as any binary multi-
10　　plications or divisions on multiples of 2 only require
the operand to be shifted to the left or right within
the operation register of the microprocessor 4. Having
thus chosen the standard values that are to be used as
the parameters for calibration tokens A and B the typical
15　　values shown in Table I have to be modified to apply a
similar modification to the values for each signal for
each of the coins. Thus, the standard values of the
parameter signals of the tokens and coins that are to be
used and stored in PROM 5 are shown in Table II. All of
20　　the values in Table II are whole numbers in a range from
0 to 255 and thus can be readily handled by the micro-
processor 4.

T A B L E   I I

| | Standard Parameter Signals | |
	Inductance Value x	Loss Value y
Calibration token A	$x_A = 32$	$y_A = 32$
Calibration Token B	$x_B = 96$	$y_B = 96$
50p coin	$x_{50} = 94$	$y_{50} = 144$
10p coin	$x_{10} = 72$	$y_{10} = 125$
5p coin	$x_5 = 14$	$y_5 = 27$
2p coin	$x_2 = 16$	$y_2 = 11$

To calibrate the PROM 3, the microprocessor 2   is
replaced by the microprocessor 4 and PROM 5 and then cali-
bration token A is inserted into the coin test section.
Typically a push button switch is also actuated such

5   as switch 1 shown in Figure 3, to inform the microprocessor
4 that a calibration token is being inserted or,
alternatively, the operation can be triggered automatically
for the first coin or token that enters the coin test
section 1 when the PROM 3 is in its virgin or unprogrammed

10   state.   The coin test section 1 performs its standard
testing operations on the calibration token A and two
parameter signals are produced by and output from the
coin test section 1 into the microprocessor 4.   The
values of these determined parameter signals are then

15   stored in an internal memory of the microprocessor 4.
Token A is then rejected and calibration token B
inserted into the coin test section 1.   A push button
switch such as switch 2 shown in Figure 3 is also actuated
to inform the microprocessor that token B has been inserted

20   or if the calibration sequence is triggered automatically
then the microprocessor 4 expects the next token to be
token B.   The coin test section 1 then performs its tests
on reference token B and again determined values of the
parameter signals are output into the microprocessor 4

25   where they are stored in an internal memory.   The micro-
processor then compares the determined parameter signal
values for the calibration tokens A and B with the standard
values for the calibration tokens shown in Table II which
it draws from the PROM 5.   From these reference values

30   it computes calibration factors a, b, c and d using an
algorithm derived as follows.
As mentioned earlier the reference values of the
parameter signals can be thought of as representing
co-ordinates of points on a graph having the inductance

35   values along one axis - say the X axis and the loss factor

values along the other axis - say the Y axis. In this
case the calibration factors (a, b, c and d) are used to
define the offset to be applied to the origin of the
axes - factors a and c, and the scaling factors to be
applied to the axes - factors b and d. Thus if $A_{(x)}$ and
$A_{(y)}$ are the determined parameter signal values for
the calibration token A, $B_{(x)}$ and $B_{(y)}$ are the determined
parameter signal values for the calibration token B, and
x_A and y_A are the standard values of the parameter signals
for calibration token A and x_B and y_B are the standard
parameter signals from reference token B then:-

$$A_{(x)} = a + b.x_A \quad \ldots \text{(1)}$$
$$A_{(y)} = c + d.y_A \quad \ldots \text{(2)}$$
$$B_{(x)} = a + b.x_B \quad \ldots \text{(3)}$$
$$B_{(y)} = c + d.y_B \quad \ldots \text{(4)}$$

Calibration factor a is equal to the offset of the X
axis of the graph, b is the scaling factor of the X
axis, calibration factor c is the offset on the Y axis
and calibration factor d is the scaling factor of the
Y axis. Then, from equations (1) and (3),

$$b = \frac{A_{(x)} - B_{(x)}}{x_A - x_B} \qquad \ldots \text{(5)}$$

and
$$a = A_{(x)} - x_A . \left\{ \frac{A_{(x)} - B_{(x)}}{x_A - x_B} \right\} \qquad \ldots \text{(6)}$$

and similarly from equations (2) and (4)

$$d = \frac{A_{(y)} - B_{(y)}}{y_A - y_B} \qquad \ldots \text{(7)}$$

and
$$c = A_{(y)} - y_A . \left\{ \frac{A_{(y)} - B_{(y)}}{y_A - y_B} \right\} \qquad \ldots \text{(8)}$$

The computed values of these correction factors
a, b, c and d are again stored in an internal memory of
the microprocessor 4. The microprocessor 4 then computes
in respect of each of the standard parameter signal
values of the set of coins contained in the PROM 5 the
individual reference values for the parameter signals of
each of the coins appropriate to that particular coin
test section 1, and programs these into the PROM 3. To
do this, the microprocessor 4 uses an algorithm derived
as follows:-

Let $50_{(x)}$ be the individual reference value for
the inductance value of a 50p coin required to be
programmed into the PROM 3 and let x_{50} be the standard
value (shown in Table II) contained in the PROM 5. Then,
by an equation similar to equations 1 to 4

$$50_{(x)} = a + b.x_{50} \qquad \cdots \quad (9)$$

$$50_{(y)} = c + d.y_{50} \qquad \cdots (10)$$

Also let Δ_{50} be the difference between $50_{(x)}$ and x_{50}.
Thus from equations 9, 5 and 6,

$$\Delta_{50} = A_{(x)} - x_A \cdot \left\{ \frac{A_{(x)} - B_{(x)}}{x_A - x_B} \right\} + \left\{ \frac{A_{(x)} - B_{(x)}}{x_A - x_B} \right\} x_{50} - x_{50} \qquad \cdots (11)$$

However, we know that $x_A = 32$ and $x_B = 96$ from Table II.
So,

$$\Delta_{50} = \frac{3A_{(x)}}{2} - \frac{B_{(x)}}{2} - \frac{x_{50}}{64} \left\{ A_{(x)} - B_{(x)} - 64 \right\} \qquad \cdots (12)$$

then let

$$\delta_A = A_{(x)} - x_A \text{ and } \delta_B = B_{(x)} - x_B$$

so

$$\Delta_{50} = \frac{x_{50}}{64} (\delta_A - \delta_B) + \frac{3}{2} \delta_A - \frac{\delta_B}{2}$$

then let

$$p = \delta_A - \delta_B \text{ and } q = \delta_A - \delta_B + 2\delta_A$$

$$p = A_{(x)} - B_{(x)} + 64, \quad q = 2.(A_{(x)} - 32) + p$$

so

$$\Delta_{50} = (\frac{-x_{50} \cdot p}{64} + \frac{q}{2}) \qquad \qquad \dots (13)$$

A similar algorithm can be derived for the y axis 50p coin value and for the x and y values of each of the other coins. The computer solves equation 13 and the equivalent one for the y axis using of course the derived parameter signal values from the tokens A and B for the values of $A_{(x)}$, $A_{(y)}$, $B_{(x)}$, $B_{(y)}$ and substitutes the value from the PROM 5 for the X_{50} and Y_{50}. The computer then derives the individual reference values $50_{(x)}$ and $50_{(y)}$ and loads these values into the PROM 3. The process is repeated for each of the other coins.

The microprocessor 4 and PROM 5 are removed after the PROM 3 has been programmed and the original microprocessor 2 replaced to provide a complete and calibrated coin validation apparatus as shown in Figure 1.

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C L A I M S

1.   A method of calibrating a coin validation apparatus including a coin testing section and a programmable memory comprising subjecting two tokens successively to a coin test using the coin testing section to determine the values of two parameter signals for each token which are characteristic of the effect of each token on the coin testing section, comparing these determined parameter values for the two tokens with standard values of the parameter signals for the two tokens and computing from the determined parameter values and the standard values calibration factors relevant to that particular coin testing section, then operating on standard values of the parameter signals for a set of coins to be used with the coin validation apparatus using the computed calibration factors to compute individual reference values of the parameter signals for each coin in the set appropriate for that particular coin testing section, and programming the programmable memory with these computed individual reference values.

2.   A method according to claim 1, in which the calibration sequence is initiated in response to the first coin or token introduced when the programmable memory is in its virgin state.

3.   A method according to claim 1 or 2, in which the standard values of the parameter signals for the tokens and for the coins acceptable to the coin validation apparatus contained in the programmed memory do not correspond to the exact values of the parameter signals emitted by a standard coin test section but are presented in a modified form to facilitate the computation to be performed, the modification of the standard values being taken account of in the calculation of the calibration factors.

4.   A calibration unit for calibrating a coin
validation apparatus including a coin testing section
(1) and a programmable memory (3) comprising two tokens,
a programmed memory (5) containing standard values of
5   the parameter signals for the said two tokens and
standard values for coins acceptable to the validation
apparatus, and computer means (4) programmed to accept
from the coin testing section (1) determined values of
two parameter signals for each token which are character-
10   istic of the effect of each token on the coin testing
section (1), to compare these determined parameter values
for the said two tokens with the standard values of the
parameter signals for the two tokens stored in the pro-
grammed memory (5), to compute from the determined para-
15   meter values and from the standard values of the parameter
signals for the two tokens, calibration factors relevant
to the coin testing section (1) of that particular coin
validation apparatus, to operate on the standard
values of the parameter signals for the coins acceptable to
20   the coin validation apparatus stored in the programmed
memory (5) using the computed calibration factors to
compute individual reference values of the parameter
signals for each coin acceptable to the coin validation
apparatus appropriate for that particular coin testing
25   section (1), and to program the programmable memory (3)
of the coin validation apparatus with these computed
individual reference values of the parameter signals.
5.   A calibration unit according to claim 4, which
comprises a microprocessor (4) forming the computer
30   means coupled to the programmed memory (5), the micro-
processor (4) being of the same type as that (2) used
in the coin validation apparatus, during calibration of

the apparatus the microprocessor (4) replacing the
microprocessor (2) normally used in the coin validation
apparatus.

6. A coin validation apparatus including a coin
5 testing section (1) for testing a coin and determining
the values of two parameter signals which are charac-
teristic of the effect of the coin on the coin testing
section (1), a programmable memory (3) for storing
individual reference values of the parameter signals
10 corresponding to valid coins acceptable to the coin
validation apparatus, two tokens, a programmed memory
(5) containing standard values of the parameter signals
for the said two tokens and standard values of the
parameter signals for coins acceptable to the coin
15 validation apparatus, and computer means (4) programmed
to accept from the coin testing section (1) determined
values of the two parameter signals for each token which
are characteristic of the effect of each token on the
coin testing section (1), to compare these determined
20 parameter values for the two tokens with the standard
values of the parameter signals for the two tokens stored
in the programmed memory (5), to compute from the
determined parameter values and from the standard values
of the parameter signals for the two tokens; calibration
25 factors relevant to the coin testing section (1) of that
particular coin validation apparatus, to operate on the
standard values of the parameter signals for the coins
acceptable to the coin validation apparatus stored in the
programmed memory (5) using the computed calibration
30 factors to compute individual reference values of the
parameter signals for each coin acceptable to the coin
validation apparatus appropriate for that particular coin

- 20 -

testing section (1), and to program the programmable
memory (3) of the coin validation apparatus with these
computed individual reference values of the parameter
signals.

5 7.   A coin validation apparatus according to claim 6,
in which the computer means (4) for calibrating the
apparatus is the same microprocessor as is used in the
coin validation apparatus to control the apparatus and to
analyse the output of the coin test section (1).

10 8.   An apparatus according to claim 7, also including
means to initiate the calibration sequence in response
to the actuation of a switch or in response to the
first coin or token introduced when the programmable
memory is in its virgin state.
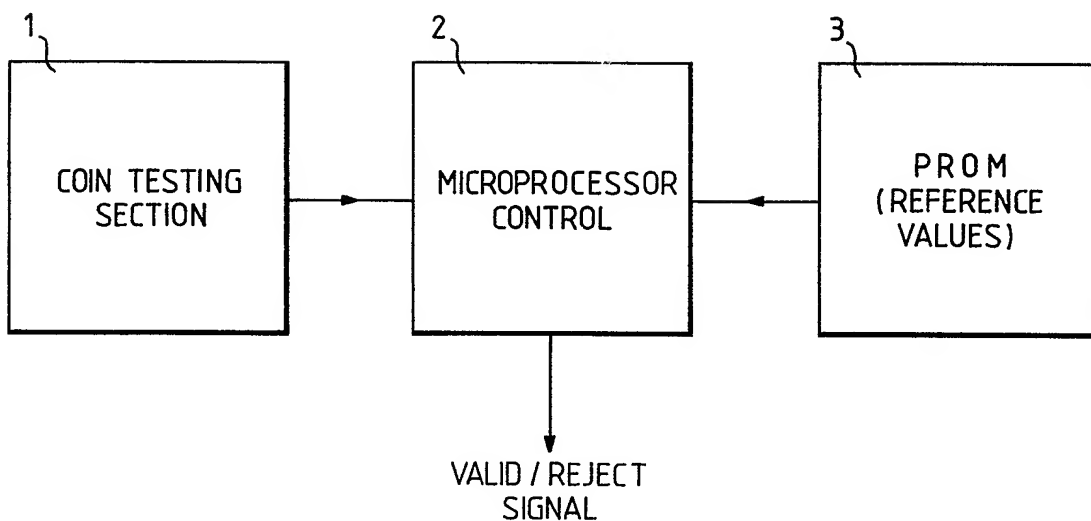
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Fig.1.

COIN TESTING SECTION → MICROPROCESSOR CONTROL ← PROM (REFERENCE VALUES)

VALID / REJECT SIGNAL

Fig.2.

COIN TESTING SECTION → MICROPROCESSOR CONTROL AND CALIBRATOR → PROM (REFERENCE VALUES)

PROM (STANDARD VALUES

Fig.3.

COIN PRESENCE

FREQ 1 ——→

FREQ 2 ——→

SWITCH 1 ——→

SWITCH 2 ——→

CONTROL
APPARATUS
(MICROPROCESSOR
AND PROGRAM)

——→ READ / WRITE

——→ PROGRAM COMMAND

ADDRESS
BUS

DATA
BUS

Fig.4.

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IN

IS COIN PROM VIRGIN

NO → NORMAL COIN VALIDATION

YES → WAIT FOR TOKEN TO BE ENTERED

MEASURE TOKEN AND STORE VALUES

REJECT TOKEN

WAIT FOR SECOND TOKEN

MEASURE TOKEN

REJECT TOKEN

IS IT A DIFFERENT TOKEN

NO

YES → STORE VALUES

COMPUTE COIN VALUES

ARE THEY SENSIBLE VALUES

NO → EXIT

YES → COMPUTE UPPER AND LOWER LIMIT VALUES FOR COINS

STORE IN COIN PROM

→ EXIT
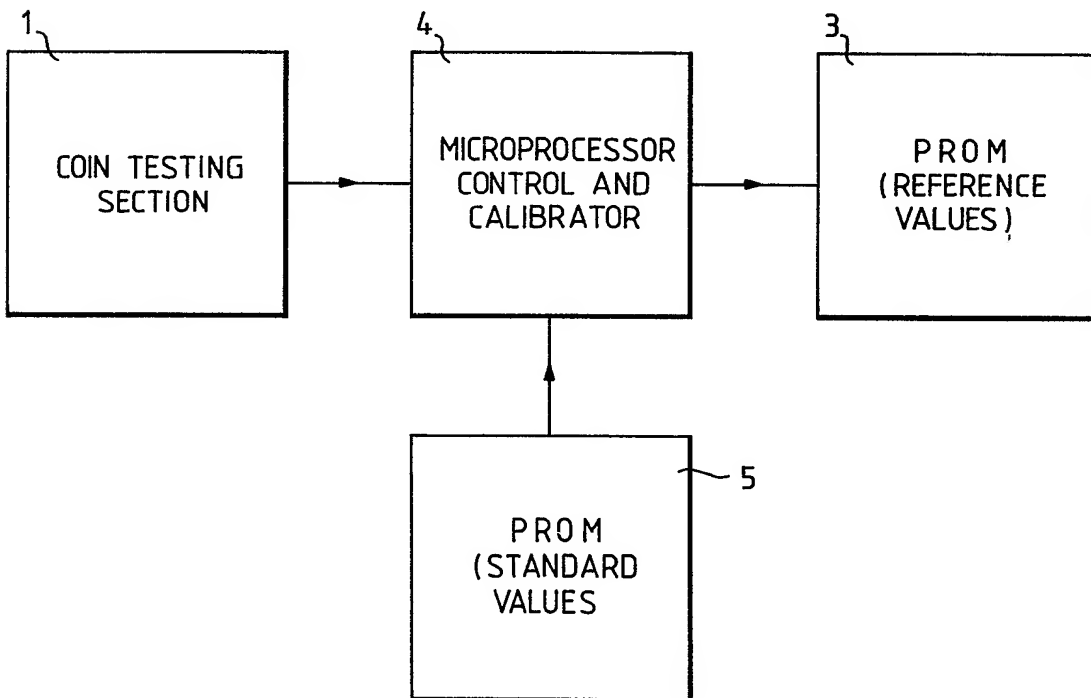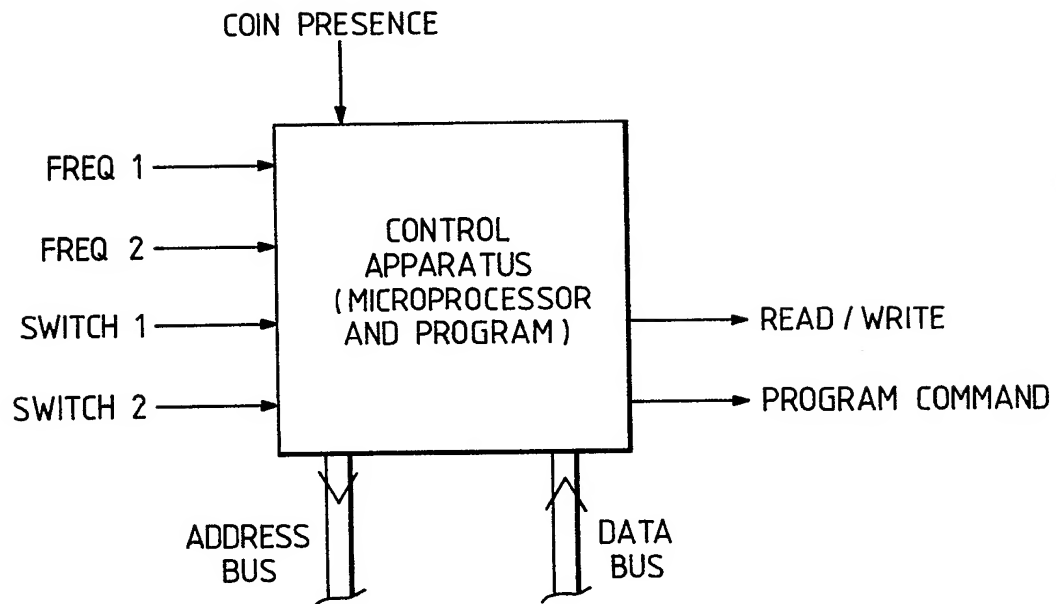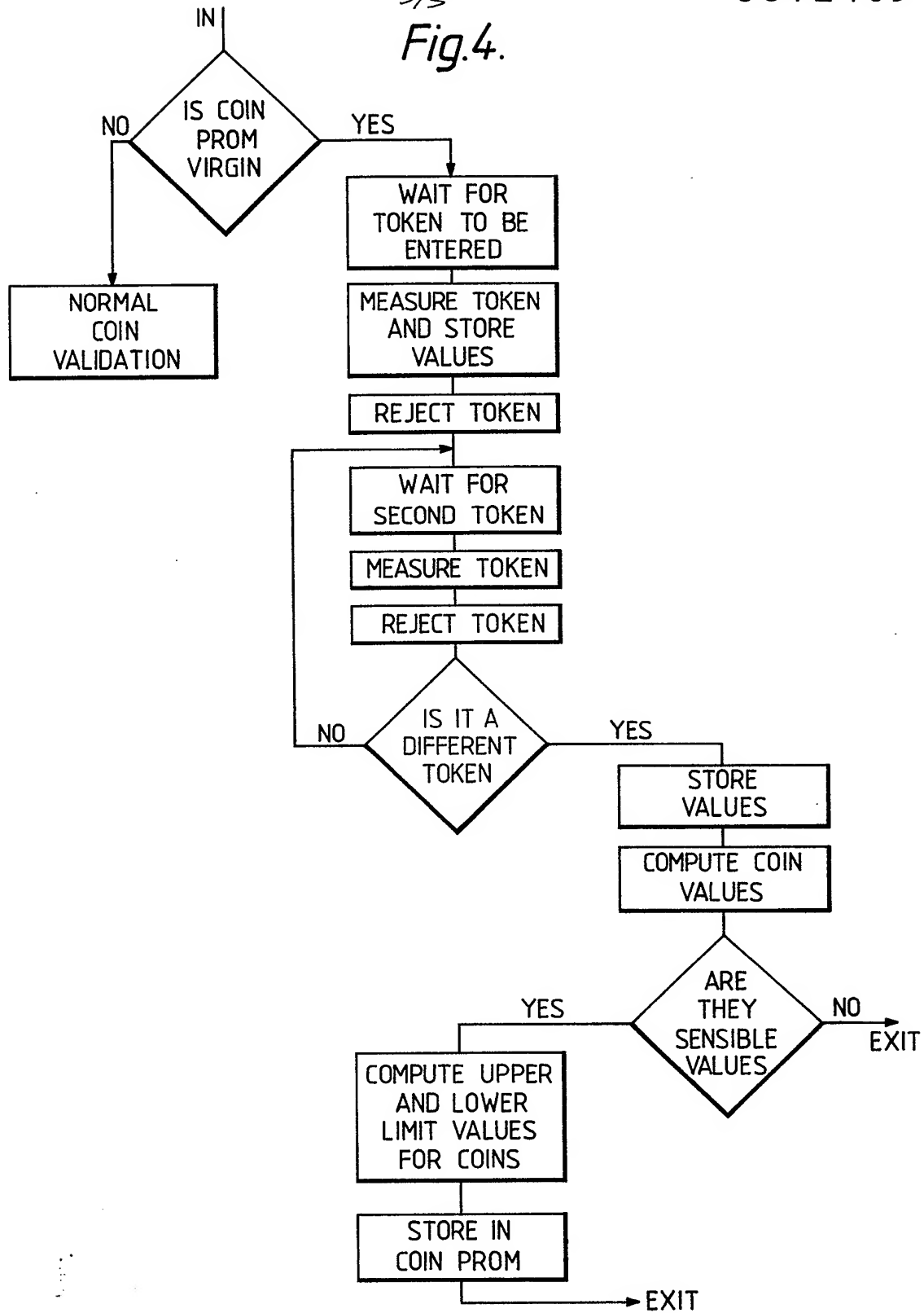
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INVENTOR-INFORMATION:

NAME   COUNTRY

DAW, RONALD EDGAR   N/A

ASSIGNEE-INFORMATION:

NAME   COUNTRY

AERONAUTICAL GENERAL INSTR   GB

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ABSTRACT:

    CHG DATE=19990617 STATUS=O> A method of

calibrating a coin validation apparatus including a coin testing section (1) and a programmable memory (3) comprises subjecting two tokens successively to a coin test using the coin testing section (1) to determine the values of two parameter signals for each token which are characteristic of the effect of each token on the coin testing section (1). These determined parameter values for the two tokens are then compared with standard values of the parameter signals for the two tokens, and from the determined parameter values and the standard values, calibration factors relevant to that particular coin testing section (1) are computed. Standard values of the parameter signals for a set of coins to be used with the coin validation apparatus are then operated on using the computed calibration factors to compute individual reference values of the parameter signals for each coin in the set appropriate for that particular coin testing section (1). Finally, the programmable memory (3) is programmed with these computed individual reference values. An apparatus for performing this method includes two tokens, a programmed memory (5) containing standard values of the parameter signals for the said two tokens and standard values for coins acceptable to the validation apparatus, and a programmed computer (4).